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Psychometric Properties of the Persian Version of the Revised Implicit Theories of Intelligence (Self-Theory) Scale in High School Students

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Abstract

Background: In a revision on the measurement of the implicit theories of intelligence, the Self-Theory Scale is suggested.
Objectives: The main purpose of the present study was to examine reliability and validity of the Persian version of the Revised Implicit Theories of Intelligence (Self-Theory) scale in a sample of Iranian high school students.
Methods: A sample of 450 unpaid students (255 females and 255 males), aged between 14 and 18 years old (16.73 $\pm$ 0.81 years) in the academic year of 2015 to 2016, were selected through multi-stage clustered sampling from the city of Ray, Iran. All participants were asked to complete a demographic form, the Revised Implicit Theories of Intelligence Scale, and the Implicit Theories of Intelligence Scale (ITIS).
Results: The findings from confirmatory factor analysis confirmed the factor structure of the Persian version of the Revised Implicit Theories of Intelligence Scale. The convergent validity of the scale was supported by an expected pattern of correlations between the Revised Scale and the ITIS ($P < 0.05$). The obtained internal consistency coefficients (Cronbach's α) were reasonable.
Conclusions: The results suggest that the Persian version of the Revised Implicit Theories of Intelligence (Self-Theory) Scale is a reliable and valid measure in high school students.

Keywords: Factor Analysis, Intelligence, Psychometrics, Students

1. Background

Studying the validity and reliability of instruments that survey students' beliefs about the nature of intelligence has been the focus of attention of researchers for several reasons. First of all, according to previous findings (1), personal beliefs could strongly anticipate educational goals, attributions, and functions. Students' beliefs about the nature of intelligence could especially shape their goals and attributions (2, 3). This could, to a large extent, influence choosing goals and attributions, and brings about a broad range of educational consequences for students including progress - test marks (4); moreover, it could be accompanied by self - handicapping behaviors, lower - than - capability progress, and course challenge avoidance (5). Another important reason, according to De Castella and Byrne (2015), is that students may have different ideas about the nature of intelligence for themselves and for others, thus the instruments should precisely reflect the "personal" beliefs that guide the thoughts and behavior of the students (6). In the field of "implicit theories of intelligence", Dweck (1999) conveyed that students usually have two approaches to intelligence: Some believe that intelligence is nothing more than a fixed and inflexible "essence" (entity beliefs), while others see it as something malleable and flexible, which could be improved and shaped (incremental beliefs) (3). Since these fundamental beliefs are connected to complex networks of meaning construction and due to the fact that they are not usually considered consciously, they are also referred to as "implicit theories" (6). If people conceive intelligence as fixed (i.e. hold an entity theory), they prefer performance goals; if they conceive intelligence as malleable (i.e., hold an incremental theory), they prefer learning goals and believe that they can expand intelligence by effort (7). Individuals, who believe intelligence is malleable (a growth mindset) are better able to bounce back from failures than those, who believe intelligence is immutable (8). However, in educational situations, implicit theories of intelligence have seldom been assessed through questioning about students' views on flexibility or inflexibility of intelligence as a *general* construct. For instance: "you have a fixed intelligence and there is no way you could change

it at all". In spite of self-efficacy and self-concept, which assess students' beliefs about their practical abilities (9), implicit theories only consider students' beliefs about their potential for change. Although, accepting the flexibility of intelligence could help progress and motivation (3, 4), it is worth noting that students' beliefs in the possibility of improvement and promotion of intelligence does not necessarily mean that they believe in their ability to promote their "own" intelligence (6). In other words, confirming incremental or entity beliefs, more or less depends on whether one is assessing his/her own abilities or those of others. According to De Castella and Byrne (2015), students with stronger entity beliefs about their own intelligence (for example, "expressing that intelligence might be flexible, but not for me") might be vulnerable to self - handicapping, helplessness or evading educational challenges, and students' implicit beliefs, particularly about their own intelligence, may have important implications for their motivation, engagement, and performance at school (6). Therefore, considering the effects of implicit theories on students' educational life, the existing scales should be precisely coordinated with personal beliefs (about self), which most probably lead to thoughts and behaviors of students. These scales have traditionally assessed students' beliefs about the fixed or flexible nature of intelligence totally or generally, while it is not clear whether (and to what extent) the general implicit theories of students are different from their ideas about their own abilities. Hence, implicit theories instrument, which is sensitive to these differences has many theoretical and practical advantages and could also possibly influence the interventions, which are planned for self-limiting beliefs (6).

2. Objectives

Considering the importance of revising the measurement of implicit theories of intelligence, the present study was designed to investigate the psychometric properties of the Persian version of Revised Implicit Theories of Intelligence (Self-Theory) Scale (6) in students and educational situations.

3. Materials and Methods

3.1. Statistical Population, Sample and Sampling Method

The statistical population of the present study included all high school students (females and males) in the city of Ray (the 20th district of Tehran). Overall, 450 students (225 males and 225 females), aged 14 to 18, in the academic year of 2015 to 2016, were selected through the multi-stage cluster sampling method. First, out of three education areas of Ray, two were chosen randomly (area one and two). Then, boys' and girls' high schools were selected randomly (overall 14 schools). In the next stage, three classes of second and third grades were chosen by chance from each high school, and finally in each class, students were chosen randomly to answer the research instruments. The mean age was 16.73 (SD = 0.81) [16.81 for boys (SD = 0.72) and 16.64 for girls (SD = 0.81)]. Overall, 50% of the samples were studying mathematics, 23% science, and 27% humanities.

3.2. Instruments

3.2.1. Persian Version of the Revised Implicit Theories of Intelligence (Self-Theory) Scale

This scale was created by De Castella and Byrne (2015), by revising items of the general version of Implicit Theories of Intelligence Scale (6). The revised version consists of eight items (four related to the belief in entity theory of intelligence and four related to the belief in one's incremental intelligence) with Likert scale multiple choice from 1- completely disagree to 4- completely agree, and studies students' beliefs about their abilities in developing their intelligence, compared with their beliefs about flexibility of intelligence in general. For instance, in the revised version, instead of "you have a certain amount of intelligence and you cannot really do much to change it" there is "I don't think I personally can do much to increase my intelligence". De Castella and Byrne (2015), using Cronbach's alpha, reported internal consistency of self-theory version as 0.90 in a sample of Australian high school students (age range: 15 to 19, 62% females); moreover, applying confirmatory factor analysis, they confirmed fitness indexes of its two-factor structure (χ^2 = 95.40, P < 0.05, df = 19, GFI = 0.96, CFI = 0.98, RMSEA = 0.08). The indexes were more reasonable than Dweck's general version. Furthermore, they reported that the two-factor structure of the revised scale has better fitness with data, compared with the one-factor model. They reported factor loading for items of self-theory between 0.73 and 0.91, and 0.84 to 0.91 for the factors of belief in entity intelligence and belief in incremental intelligence, respectively (P < 0.001) (6).

3.2.2. Implicit Theories of Intelligence Scale (ITIS)

This scale (10) was first codified according to Dweck's mindset theory (11). This scale has 14 items; seven for assessing the subscale of entity theory (belief in inflexibility of intelligence) and seven for assessing the incremental theory of intelligence (belief in incremental intelligence). Some instances of this instrument's substances are as follows: "we are born with a fixed level of intelligence and this will not change through our life" (for entity theory) and "doing homework successfully will improve our intelligence"

(for incremental theory). The scoring method is based on a Likert - type four–grade system, arranged from "completely disagree" (1) to "completely agree" (4). In a statistical population of 350 Iranian students, Mohebbi Nour-El-Dinvand et al. (2014), through Cronbach's alpha, reported internal consistency for sub-scales of entity intelligence and incremental intelligence as 0.82 and 0.74, respectively; moreover, they confirmed the fitness index of two-factor structural model, applying the confirmatory factor analysis (χ^2 = 201.43, P < 0.05, df = 76, GFI = 0.94, CFI = 0.91, RMSEA = 0.07) (12). In the present study, Cronbach's alpha for entity intelligence and incremental intelligence sub-scales were calculated as 0.81and 0.87, respectively; and its two-factor structural model fitness indexes were rather reasonable (χ^2 = 182.43, P < 0.05, df = 62, GFI = 0.94, CFI = 0.90, RMSEA = 0.06).

After fulfilling the required concordance between the university and ministry of education, the instruments were prepared in form of booklets with an introduction, including a brief explanation about the psychological nature of the research, and confidentiality. Supervisors informed the students that participation was voluntary and anonymous, and that there was no right or wrong answers. Before final data gathering, in a primary research, the Persian version of the scale was handed to 30 of the students and the required time for filling the scale, writing, and understanding the items was evaluated.

3.3. Data Analysis

According to the required analysis, in the present study, the scores of subjects in this scale were assigned in two ways. Each person received three points. One for belief in entity intelligence, one for belief in incremental intelligence, and a total score by reversing the answer of the items related to subscale of belief in incremental intelligence. Internal consistency (Cronbach's alpha) was used to analyze the reliability of the scale. To analyze validity, the researchers used Pearson Correlation Coefficient calculation between the sub scales of the ITIS (10) and the revised version; Pearson correlation coefficient calculation between sub scales of the revised version and the total score of this scale; and confirmatory factor analysis using Structural Equation Modeling (SEM). Data analysis was done using the SPSS 22 and AMOS 20 software.

4. Results

4.1. Reliability

Missing data was rare (< 0.05%). In Table 1, mean and standard deviation of the sub scales of belief in entity theories of intelligence and incremental intelligence in addition to Cronbach's alpha coefficients were reported both for the total samples and for males and females, separately. According to Table 1, all the alpha coefficients had acceptable amounts (13), and showed good internal consistency of items of the scale.

4.2. Validity

In the present study, firstly, content validity of the Persian version of the self-theory version was studied. For this purpose, at first, the scale was translated to Persian. Afterwards, this Persian version was checked by an expert English translator to confirm the equivalence of the original content and the translated version. In the next step, five psychology professors assessed the content validity of both the original and the translated version. The experts were asked to comment on the questionnaire, and after qualitative evaluation in terms of grammar, use of the right words, placement of the items, and proper scoring, modifications were applied based on their feedback. Thereupon, to test the higher order structure of the revised scale, confirmatory factor analysis was applied. In this regard, considering De Castella and Byrne's (2015) report (6), structural equation modeling was used to examine assumed two-factor structure by assessing the factor loading on entity and incremental components. The Maximum Likelihood (ML) method was used for estimation in analysis (Figure 1).

The χ^2 test assesses the discrepancy between the sample and fitted covariance matrices and decreases as model fit improves (14). Due to Chi-squared test inflation with large samples (15), other indexes, including Goodness of Fit Index (GFI), Adjusted Goodness of Fit Index (AGFI), Comparative Fit Index (CFI), and Root Mean Square Error of Approximation (RMSEA), were also considered. For model fit index values, Byrne (2010) reported that values higher than 0.90 were favorable for CFI, GFI, and AGFI (16). Browne and Cudenck (1993) reported that values lower than 0.08 were acceptable for RMSEA, although they reported that the ideal value was lower than 0.05 (17). According to Ullman's report (2001), values lower than two or three are acceptable for relative chi-squared index (χ^2/df) (18). These findings are reported in Figure 1. Since the d^2 values were not obviously separated (16), there was no problem regarding multivariate outliers.

The goodness of fit statistics indicated that the theoretical model had a reasonable fitness with the data. Contents of Figure 1 show that all the Persian version items had acceptable coefficients. All latent variables and factor loadings were significant. Moreover, the correlation coefficient of the two subscales of entity and incremental intelligence theories was -0.69, which is another evidence of the construct validity of the scale. The validity of the Persian version of self-theory scale of implicit theories of intelligence

Table 1. Mean, Standard Deviation and Internal Consistency in Components of the Persian Version of the Revised Implicit Theories of Intelligence (Self-Theory) Scale for Males, Females and the Total Sample

	Males			Females			Total		
	Mean	SD	Alpha	Mean	SD	Alpha	Mean	SD	Alpha
Belief in entity intelligence	8.07	2.81	0.81	7.61	2.22	0.86	7.84	2.54	0.84
Belief in incremental intelligence	11.77	2.77	0.86	12.37	2.10	0.89	12.07	2.47	0.87

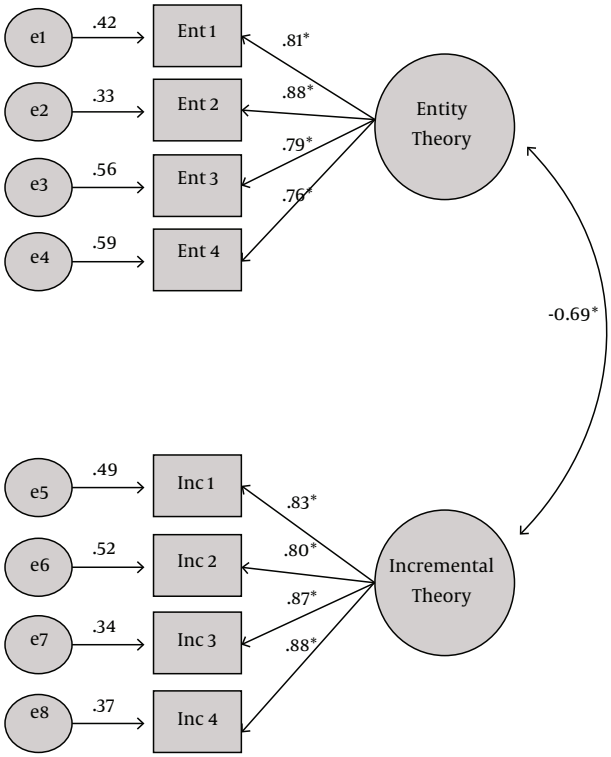

Figure 1. Confirmatory factor analysis model of the Persian version of Revised Implicit Theories of Intelligence (Self-Theory) Scale with factor loadings. Note: Factor loadings are standard coefficients ($P < 0.01$). Error variances are presented as unstandardized scores. $\chi^2/df = 2.55$, $P < 0.001$, GFI = 0.94, AGFI = 0.90, CFI = 0.95, RMSEA = 0.07, Hoelter Index = 242 at 0.01 level.

was assessed through calculating correlation coefficients of its subscales with the total score of the scale. These coefficients for both of the subscales, believing in entity theory of intelligence ($r = 0.45$) and believing in incremental intelligence ($r = 0.32$), was significant ($P < 0.01$), which confirms the construct validity of self-theory scale. An expectable model of correlation coefficient was reached between subscales of ITIS (10) and the Persian version of the Revised Implicit Theories of Intelligence (Self-Theory) scale, which confirms convergent validity of self-theory scale (Table 2).

In addition to the findings related to psychometric properties of the scale, differences in students' scores in each of the subscales of ITIS and the self-theory scale were analyzed through within - subjects *t* - test (paired samples *t* - test). In other words, in spite of equal responsiveness spectrum of the two scales, the number of their items was different. Therefore, students' scores in each subscale of the first scale were equal to their score in the similar subscale of the second scale, through proportionating. Findings revealed that the mean of belief in entity intelligence theory, according to self-theory scale ($M = 7.81$), is significantly lower than the mean of belief in entity intelligence theory, calculated by ITIS ($M = 8.47$) [$t(449) = 5.15$, $P < 0.001$]. Regarding the mean of belief in incremental intelligence, the score differences in two scales of self-theory ($M = 12.08$) and ITIS ($M = 11.96$) were not significant [$t(449) = -1.06$, $P < 0.28$]. In the present study, the difference between the scores as a result of different scales were also analyzed by another method. This means that in both scales, the value of the answers of items related to the belief in incremental intelligence were reverted and one total score for belief in entity intelligence theory was calculated for both scales, and finally, the total scores of both scales were equaled for each respondent and the scores were compared by the *t* - test. The findings showed that the mean of total score for belief in entity intelligence theories, according to the self-theory scale ($M = 15.73$) was significantly lower than the mean of belief in entity intelligence theories, measured by ITIS ($M = 16.49$) [$t(449) = 3.76$, $P < 0.001$). The other finding of the present research revealed that the mean of belief in incremental intelligence in both males ($M = 11.77$) and females ($M = 12.37$) was higher than the mean of belief in entity intelligence theories (males = 8.07 and females = 7.61). The difference between male's and female's scores was studied through two methods. First, the results of independent - samples *t* - test for using the total score of believing in entity intelligence theories (scores resulted from reversing the answers of items related to incremental intelligence belief) showed that the mean of believing in entity intelligence was significantly lower in females ($M = 15.20$) than in males ($M = 16.27$) [$t(448) = 2.47$, $P < 0.01$]. Finally, multivariate analysis of variance (Wilk's $\lambda = 0.985$, $F = 3.36$, $P < 0.03$) showed there was no significant difference between males and females concerning the mean belief in entity intelligence theory (resulted from self-theory scale) ($F = 3.59$, $P < 0.06$). However, there was a significant difference in the mean of belief in incremental intelligence ($F = 6.70$, $P < 0.01$).

Table 2. Pearson Correlation Coefficient Between Subscales of the Persian Version of Revised Implicit Theories of Intelligence (Self-Theory) Scale and IT IS

Self-theory scale of implicit theories of intelligence	IT IS					
	Believing in Entity Intelligence			Believing in Incremental Intelligence		
Subscales	Boys	Girls	Total	Boys	Girls	Total
Believing in entity intelligence	0.34[a]	0.49[a]	0.41[a]	-0.38[*]	-0.41[a]	-0.34[*]
Believing in incremental intelligence	-0.31[a]	-0.43[a]	-0.36[a]	0.51[a]	0.55[a]	0.53[a]

[a] $P < 0.01$.

5. Discussion

This research aimed at studying the psychometric properties of the Persian version of the Revised Implicit Theories of Intelligence (Self-Theory) Scale in a sample of high school students. Internal consistency of the items of subscales of the Persian version of the revised scale was calculated using Cronbach's alpha, which showed acceptable amounts. Convergent validity of the Persian version was studied by simultaneous implication of IT IS (10). There was a significant correlation coefficient between subjects' scores. Moreover, positive and significant correlation coefficients between subscales and the total score confirmed the validity of the Persian version. The results of confirmatory factor analysis showed that the two-factor model of the Persian version was confirmed, which was in coordination with De Castella and Byrne's (2015) report about reasonability of fitness index of two-factor structure of the revised version (6). In general, findings of the present study confirmed the psychometric properties of the Persian version of Revised Implicit Theories of Intelligence (Self-Theory) Scale in the high school student population.

The findings of the present study, in coordination with previous research (6) showed that students confirmed less entity beliefs when they were questioned about their personal ability to improve their intelligence, than when they were questioned about intelligence in general. These findings are in accordance with researches, which emphasize differentiation between students' intrapersonal and interpersonal (normative) grading about their capacity to improve their educational competencies (19). De Castella and Byrne (2015) also reported that implicit beliefs based on self-theory, compared with general implicit beliefs about intelligence indicated greater variances of achievement goal orientations, attributions, and educational outcomes. It seems that believing in "my intelligence may be more malleable than yours" can help students' educational self-concept. The results of the current study indicate that for many students, simply knowing that change is possible, does not necessarily mean that they believe in their own ability for changing their intelligence. Understanding the difference between self-theory and general implicit theories of intelligence, can be important, considering interventions and trainings related to educational progress. Hereupon, De Castella and Byrne (2015) noted that the difference between students' scores in self-theory and general scales means knowing that changing the intelligence is possible (which is taught to students in most interventions and trainings) may not be equal to personal belief in the ability to change (6). In other words, the confirmation of incremental or entity beliefs, more or less, depends on whether students assess their abilities or not. Therefore, it is suggested for researchers interested in this subject to study the consequences of the difference between beliefs related to self-theory and general implicit theories of intelligence, and the probable alteration of students' beliefs in the malleability of their *own* intelligence overtime.

The use of the revised (self-theory) scale of implicit theories of intelligence by school advisers is important from different aspects. First of all, although findings show that people believing in incremental theories of intelligence have better educational progress (12), it is important to pay attention to the different consequences of beliefs based on self-theory and general implicit beliefs of intelligence. As noted above, considering previous findings (6) and the results of the current study, students' beliefs about the possibility of improvement of intelligence, does not necessarily mean that they are completely sure that they can improve their *own* intelligence. These researchers noted that students may have different beliefs about their own and others' intelligence. On the other hand, according to De Castella and Byrne's (2015) report, personal beliefs in entity intelligence have a negative correlation with mastery - approach achievement goal orientations, and positive correlation with making attributions based on helplessness in the education process (6). Since based on the findings of the present research, there are evidences about a significant difference between male's and female's scores in implicit beliefs based on self-theory about intelligence; more researches in this field are also suggested. Considering the restrictions of the present research, it is suggested that these findings be considered as primary findings. Since implicit theories have been examined in a variety of con-

texts (6), the development of self-theory measures may thus have potential in these areas.

5.1. Conclusion

The results suggest that the Persian version of the Revised Implicit Theories of Intelligence (Self-Theory) Scale is a reliable and valid measure for high school students.

Supplementary Material

Supplementary material(s) is available here [To read supplementary materials, please refer to the journal website and open PDF/HTML].

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Footnotes

Authors' Contribution: Majid Ghaffari designed, organized and analyzed the paper. Avishan Omidmehr and Elham Yavari collected the literature and the data. Mahmoud Dehqan edited the English article.

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